3D Super Resolution

Advanced Data Fusion and Navigation Systems

Three dimensional super resolution using a Bayesian approach aims at reconstructing high resolution 3D surface computer models. Both geometry and reflectance properties are inferred from multiple images. In addition this approach allows for the use of other kinds of sensors such as radar or laser-range finders. The NASA application is useful for both planetary science and autonomous navigation.

In our application we attempt to infer the surface of the asteroid 433 Eros from images combined with laser-altimetry data taken during the NEAR (Near Earth Asteroid Rendezvous) mission. The asteroid is difficult to reconstruct because it moves and rotates constantly, providing no fixed light position. Also the image data is corrupted by an accidental blur.

Once the highly resolved model is inferred it is possible to render images in vastly higher resolution than the original images. Therefore, the reconstruction of a 3D surface from multiple images requires very accurate rendering. A problem that has to be solved along the way is the external camera calibration. We have to know the camera pose with high precision in order to start the super resolution inference. The position information that is provided by onboard equipment is not accurate enough. We have to use the observed images to also infer the asteroid position.

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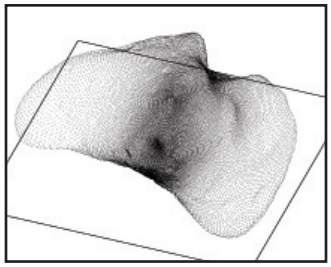
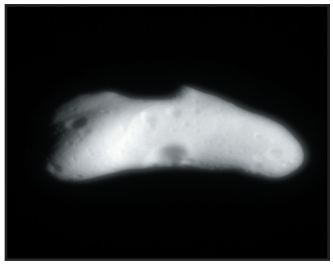
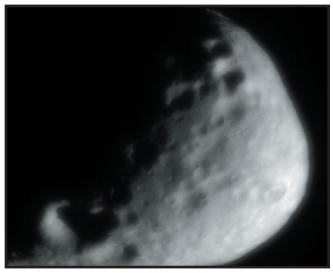


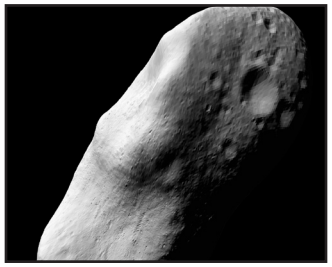
Laser altimeter data in non-uniform resolution is taken during a mission.



Low resolution images augment this data...



... each from various angles and locations....



... when analyzed, the images and altimeter data create a highly resolved 3D model from which a super resolved image is rendered